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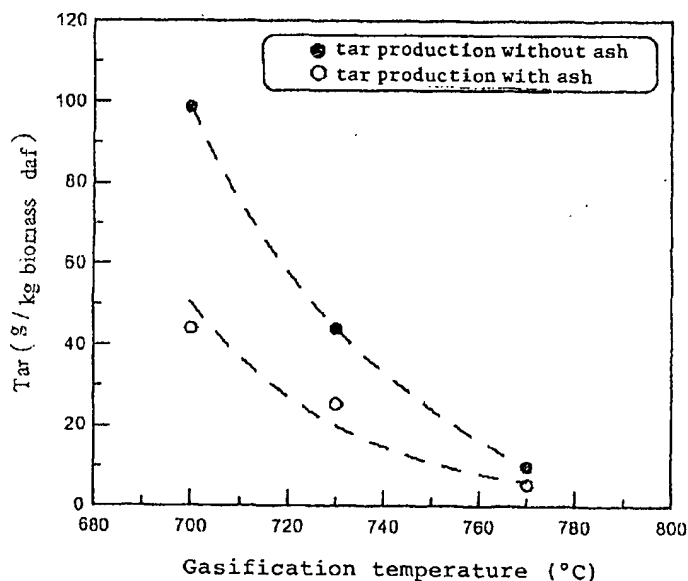
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• **ENEA - ENTE PER LE NUOVE TECNOLOGIE,  
L'ENERGIA E L'AMBIENTE**  
**00196 Roma (IT)**(54) **A process of deodorizing and damping evil-smelling organic materials from fumes and/or gases**

(57) The process of deodorizing and damping evil-smelling organic materials from fumes and/or gases provides the inlet and the intimate dispersion of solid organic and/inorganic, adsorbing and/or reactive particles which are able to provide a supporting surface for

condensation, deposition and the next separation of the materials to be removed into the gaseous medium to be deodorized. The decomposition of the collected materials is carried out in a second step providing the preferably thermal regeneration of the dusts before their recycle of partial disposal.

**FIG. 1****EP 1 238 679 A1**

## Description

### Field of the Invention

[0001] The present invention relates to a process of deodorizing and damping evil-smelling organic materials from fumes and/or gases providing the inlet and the intimate dispersion of absorbing and/or reactive solid particles which are able to provide a supporting surface for condensation, deposition and the next separation of the materials to be removed into the gaseous medium to be deodorized.

[0002] The decomposition or the separation of the collected materials from the absorbing powder particles is carried out in a second step of preferably thermal regeneration of the powder particles before their recycle or partial disposal.

### State of Art

[0003] The deodorization of fumes and more generally the damping of small amounts of undesired generally organic materials, when the latter come from incomplete combustion, is generally carried out by a reheating process. This is made by means of a specific apparatus in which fumes are brought to high temperature by inlet of generally gaseous fuel (natural gas) and oxygen in the presence of suitable catalyzers.

[0004] Even energetic cost of such system is often prohibitive considering that a great amount of air with low thermal coefficient should be brought to high temperature without any possibility of regenerating the produced energy. Therefore, this solution is used in great industrial installations and when the gaseous medium to be deodorized has a large enthalpy or heat content before the reheating process.

[0005] When the materials to be removed are present in a gaseous medium which has not enough high temperature to allow its reheating, other systems such as filtration on biologically active materials (biofilters) or an usual treatment with liquids in scrubbers are effectively used.

[0006] Scrubbers are almost used especially employing water as liquid which is the medium in which the substances extracted from the gaseous stream are flowing.

[0007] Depuration of water or water solution of a specific reagent is a problem involving high cost which cannot easily be solved.

[0008] In the field of pollution of the olfactory sensation the thresholds of evil-smell tolerance are being studied. In Italy there is no specific standard or limit values for the evil-smell emissions. ANPA (National Agency for the Protection of Environment) has launched a smell measurement campaign by means of human and electronic "noses". The sensorial methods, however, do not allow single chemical elements to be detected but only permit a reliable opinion on the olfactory nuisance to be given.

[0009] Evil smells (but not toxic emissions) do not harm or damage the health seriously until the olfactory detection of a certain concentration thereof and the stay time of the subject in contact therewith do not exceed the limit of the tolerance threshold. However, such evil smells irritate and sometimes are unbearable causing side effects such as difficulty of concentration, state of depression, sick feeling and retching. Well-known examples are rubbish dumps, cattle-breeding but also coffee roasting and biscuit factories insofar as the nuisance comes not only from inherently unpleasant smells but also from pleasant smells with high intensity and/or continuous emission. Sensational examples are fast foods and the already known "smog burger" effect associated thereto. A research carried out by California University showed that restaurants and fast foods of the district of Los Angeles give out 19 tons of organic materials per day, i.e. about 1.5 tons more than the major oil refineries in the same area.

### Scope of the Invention

[0010] The process of the present invention seeks to damp the unburned materials present in the baking fumes and responsible for the above-mentioned "smog burger" effect and/or a variety of similar products also with tarry origin and tendency to polymerization which are often in the form of minute particles dispersed in large amount of gases so as to make their damping by the known washing system ineffective and their reheating unfavourable.

### Description of the process

[0011] The main feature of the process consists of using solid particles with a large range of sizes and characteristics related to types and sizes of the polluting materials dispersed in the gaseous medium. The solid particles fed and dispersed into the gas stream can either be provided with capability of reaction towards the polluting materials or be inert but almost provided with a high capability of adsorption and absorption. In any case such particles should be able to provide a supporting surface for condensation, deposition and the next separation of the materials to be removed.

[0012] The particles that have captured the materials present in the gas are regenerated and reused in the capturing process. The regeneration can be carried out according to the kind of the employed dusts and the polluting materials to be removed (the latter being conventionally called tars from now on) by conventional single operations such as washing with solvents, roasting or chemical or biological treatment. It should be mentioned that the denomination "tars" refers, in addition to the smelling organic materials present in the vapour phase, also to all products similar to tar such as liquids and semi-liquids having more or less the tendency to condensation and polymerization, including deliberately also the

distillation products of fat materials from food cooking processes in such definition as well as all materials present in gaseous fuels from pyrolysis and/or thermal gasification of wastes and residual fuels, fumes of coffee roasting, mists from drying and roasting processes of other materials such as vegetable and animal flours.

[0013] According to a peculiar feature of the invention, the amount of solid particles fed and intimately dispersed into the gas stream is adjusted so that such solid particles are not completely wet by the condensing liquids and tar.

[0014] By such measure, the solid particles will be easily recovered from the gas as solid mass in the form of dry dust by means of cyclones, sleeve filters, or electrostatic filters, i.e. apparatuses typically employed for the even very extreme dust exhaustion of gases that cannot instead be used when the materials dispersed in the gas to be purified are wet or viscous or fat, thus adhering to the dust exhaustion systems and making the latter inapplicable.

[0015] The solid particles that can be used in the process of the present invention can be of the most varied types, of organic or inorganic nature, reactive or inert. In particular residual ashes from combustion processes are used as such ashes are able to provide a large supporting surface for the condensation, the deposition, and the next separation of aromatic substances such as pitch in the gas stream produced by the gasification of biomasses.

[0016] The decomposition of the materials collected with the dusts is then carried out in the thermal regeneration step of the dusts before their recycle (if such a regeneration system can be applied) or their partial disposal.

[0017] The dusts employed in the process can then be divided into two "families": disposable dusts and reusable dusts. In order to limit the financial burden, the former are used once exhausted as energy carrier. This is the case for instance of the wood flours, spent olive residues, fuels in the form of fine particles that are not provided directly for the heat regeneration but are used as energy carriers once performed their function as fume purifying means. Of course, this is the case only in particular industrial processes.

[0018] The latter family of reusable dusts is typically exemplified by mineral dusts fully or partially formed by carbonates of alkaline and alkaline-earth metals. After the first thermal regeneration these metals take the form of oxides (according to the temperature of the regeneration step) capable of reacting chemically with the polluting materials to be captured. For this purpose also ashes from biomass combustion processes can be used.

[0019] The recarbonation, which is possible in practice, produces carbonates that in turn are transformed to oxides again during the regeneration. The alkaline-earth oxides, typically lime, are materials that can easily be found, have a low cost and such features as to stand-

ardize the processes to get optimum operative conditions of the plants as far as high withstand of the dust capturing sleeve filters, regeneration times and temperatures of the exhausted oxides is concerned.

[0020] Other chemically inert dusts may be clay and diatomaceous earth: the former are effective in particular because of its fine granulometry that must be ensured; the latter because of its specific capability of capturing polluting materials within its structure. In order to improve the capture efficiency and where the financial means allows it, mixtures of both types of dusts can be used. The organic dusts also give a contribute to the heat content of the process during regeneration. Their possible incomplete combustion providing any mixture formed of oxides and carbon materials to be recycled to the capture step allows the polluting materials to be captured with high efficiency.

[0021] The thermal regeneration is carried out in a reactor in which the dusts are brought to such a high temperature as to cause the thermal cracking of the captured tars and then their combustion under controlled conditions.

[0022] The advantage of using such system over a "reheating process" is connected to the energetic efficiency. In fact, in order to ensure the thermal cracking and the next combustion of even minimum amounts of evil-smelling materials dispersed in the fumes by acting directly thereon, a very high energy consumption (often in the form of gaseous fuel in the reheating steps) is needed to bring the whole mass of the gaseous medium to the temperature at which the thermal cracking of the evil-smelling materials takes place for the time necessary to develop degradation processes effectively. According to the present invention only the limited amount of dusts that have "captured" the materials to be thermally cracked are brought to high temperature with the minimum energy consumption and the maximum efficiency under control.

[0023] In any case but in particular when the dusts to be treated include a combustible fraction in addition to the captured organic materials, the thermal regeneration system should be provided with devices able to ensure the oxidation of the volatile fraction that are given off from the regeneration oven so that the complete degradation is ensured before leaving to the atmosphere. Typically, such devices are Bunsen torches fed by gaseous fuel and provided with air excess and temperature control means and acting as catalytic aid to the combustion.

[0024] After checking of the humidity content and, if necessary, after passing through a plenum chamber (above all in case of non-thermal regeneration), the outlet dusts from the regeneration system (i.e. an oven in case the regeneration is thermal) are conveyed to the fumes to be purified by pneumatic means ensuring high dispersion and facilitating the intimate contact with the gaseous polluting medium to be purified.

[0025] Small/middle size systems let the regenerated

dust stream dispersed in air into a fume stream to be treated having the same direction of flow. Such systems provides a suitable calculation of the contact time between the two streams and the turbulence to put effectively in contact polluting materials and purifying dusts. Known systems such as baffles or static stream mixers with high efficiency are possible and their application depends on the gaseous medium flow rate and channel dirt problems, with the result of a need of maintenance and a specific design according to the circumstances.

[0026] Experimental tests carried out in a standard biomass (hazel-nut shell) gasification fluid-bed installation with inlet of dusts (ashes) in the same stream direction of the gas flow, although without enhancing the turbulence, showed that the presence of ashes reduces the content of aromatic substances, "tar" (pitch), in the gas by 50% under the same temperature. In addition, it should advantageously be noted that the content of pitch is strongly decreased even at low temperatures, thus making the excessive (expensive) increase in the temperature of the gas mass useless. The result is shown in the diagram of Fig. 1.

[0027] Industrial applications can provide the contact between dusts and gaseous medium to be purified by means of a fixed or boiling or turbulence or entrainment bed through already known industrial equipment for the neutralization of acid mists, for example by sodium bicarbonate, in spray drier towers.

[0028] In the specific case of combustible gas depuration to be made uniform as far as the content of organic tarry materials is concerned, the reactive-dust inlet device varies according to the pressure conditions of the vessel in which the gas to be treated flows. If the latter is under depression, the inlet device can take advantage of the Venturi system with the care of using a gas for the dispersion of dusts which is compatible with the gas within the vessel. In order to ensure the compatibility, a fraction of the same gas can be deviated so as to act as dust fluidization carrier.

#### Claims

1. A process of deodorizing and damping evil-smelling organic materials and tars from fumes and/or gases, **characterized in that** deodorization and damping of the organic materials and tars from gases and/or fumes are carried out by using solid particles intimately dispersed in the gaseous medium to be purified.
2. The process of claim 1, **characterized in that** the solid particles separate the organic materials both at the liquid and gaseous state from the gases without modifying the thermodynamic conditions of the gas flow.
3. The process of the preceding claims, **character-**

**ized in that** the solid particles have the known granulometry capable of damping the materials by cyclones and sleeve filters.

4. The process of the preceding claims, **characterized in that** the solid particles are organic.
5. The process of the preceding claims, **characterized in that** the solid particles have catalytic activity.
6. The process of the preceding claims, **characterized in that** the solid particles are reactive to the materials to be captured.
7. The process of the preceding claims, **characterized in that** the solid particles are provided with high capability of absorption and adsorption of the materials to be removed from the gas.
8. The process of the preceding claims, **characterized in that** the amount of the solid particles let in the gas is adjusted according to the type and the amount of the polluting medium in the gas but in such a way as to ensure that said solid particles are not completely wet by the condensing liquid and the tar.
9. The process of the preceding claims, **characterized in that** quantity and quality of the solid particles let in the gas are adjusted according to the thermodynamic, chemical conditions of the gas to be purified.
10. The process of the preceding claims, **characterized in that** the solid particles separating the polluting medium from the gas are dusts of combustible materials such as wood flours that can be used again as fuel.
11. The process of the preceding claims, **characterized in that** the solid particles are dispersed in the gas in the same or in the opposite direction of the stream or are entrained in the gas flow by the scrubbing of the gas in dust bed.
12. The process of the preceding claims, **characterized in that** static flow mixers with high efficiency are employed to put in contact polluting medium and depurating dusts effectively.
13. The process of the preceding claims, **characterized in that** the solid particles can be separated from the gas as solid masses in the form of dry dust by known dust exhaustion systems such as cyclones and/or sleeve filters and/or electrostatic filters.
14. The process of the preceding claims, **character-**

ized in that after the separation of the polluting medium from the gas, the solid particles are thermally regenerated to be used again in a following purification cycle by roasting in a regeneration oven.

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15. The process of the preceding claim, **characterized in that** there are provided devices capable of ensuring the oxidation of the volatile fractions which are given off from the oven where the regeneration takes place so as to ensure the complete degradation before their leaving to the atmosphere. 10
16. The process of the preceding claim, **characterized in that** said devices are typically Bunsen torches fed by gaseous fuel and provided with air excess and temperature control means and catalytic aid to the combustion. 15
17. The process of the preceding claims, **characterized in that**, after checking of the humidity content and, if necessary, after passing through a plenum chamber, the regenerated dusts are conveyed to the fumes to be purified by pneumatic means ensuring high dispersion and facilitating the intimate contact with the gaseous polluting medium to be purified. 20 25
18. The process of the preceding claims, **characterized in that** the dusts are mineral dusts fully or partially formed by carbonates of alkaline and alkaline-earth metals able to pass after the first thermal regeneration to the form of oxides and capable of reacting chemically with the polluting medium to be purified. 30 35
19. The process of claims 1 to 17, **characterized in that** the dusts are chemically inert dusts such as clay and diatomaceous earth.
20. The process of claims 1 to 13, **characterized in that** the dusts that have separated the polluting medium from the gas are regenerated by extraction with a solvent. 40
21. The process of claims 1 to 13, **characterized in that** the dusts that have separated the polluting medium from the gas are regenerated by washing. 45

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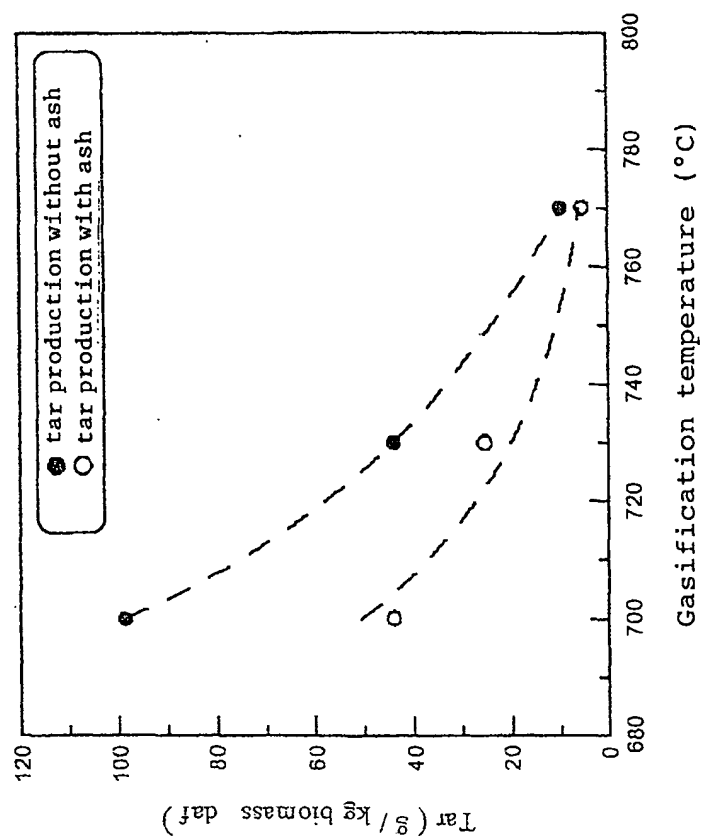


FIG. 1



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# PARTIAL EUROPEAN SEARCH REPORT

Application Number

which under Rule 45 of the European Patent Convention EP 02 42 5121 shall be considered, for the purposes of subsequent proceedings, as the European search report

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 292 285 A (NAKAO MASAOKI ET AL) 29 September 1981 (1981-09-29)  * column 2, line 20 - line 51 * * column 4, line 1 - line 36; figure 1; example 1 *	1,4-8, 10,11, 13-17	A61L9/013 A61L9/014 B01D53/06 B01D53/34 B01J8/18
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			A61L B01D B01J
INCOMPLETE SEARCH			
<p>The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims.</p> <p>Claims searched completely :</p> <p>Claims searched incompletely :</p> <p>Claims not searched :</p> <p>Reason for the limitation of the search:</p> <p>see sheet C</p>			
Place of search		Date of completion of the search	Examiner
MUNICH		14 June 2002	Jochheim, J
CATEGORY OF CITED DOCUMENTS			
<p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03/02 (P04007)



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INCOMPLETE SEARCH  
SHEET C

Application Number  
EP 02 42 5121

Claim(s) searched completely:  
1,4-8,10-21

Claim(s) searched incompletely:  
2,3,9

Reason for the limitation of the search:

The subject-matters of claims 2 and 9 apparently represent results to be achieved while it is nowhere disclosed how these results can be achieved, because these claims lack support from the description (Article 84 EPC). It is also considered unclear what the intentions behind these claims is. In claim 3 it is unclear what the "known granulometry" is supposed to be (known from where?) and there is also no support for this claim in the description.



**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 02 42 5121

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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14-06-2002

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82